What is claimed is:

1. A method for pre-stack migration of common offset seismic traces obtained from a subterranean region where the seismic velocity varies both laterally (with x) and vertically (with z), said method comprising the steps of:

a) selecting seismic velocity functions $v(z)$ at at least two lateral (x_s) locations (at least three locations for 3D application) in said subterranean region, the number of such locations being determined by the degree of lateral velocity variation;

b) transforming said common offset seismic data traces from the space-time *(x-t)* domain to the wave number - frequency *(k-ω)* domain;

c) calculating a travel time map for each x_s location using the velocity function selected for such location;

d) calculating for each travel time map from step (c) a corresponding map of τ as a function of wave number p, where $\omega\tau$ is the phase shift in the k-ω domain corresponding to the migration time shift in the x-t domain;

e) using the τ -maps to find $\tau(p)$ as a linear function of x with a certain slope at each depth *(z)* in the subterranean region;

f) forming the migrated image from said seismic traces in the ω-k domain using pre-stack time migration with k shifted by an amount equal to the τ slope from step (e) multiplied by ω; and

g) reverse transforming said migrated image back to the space-time *(x-t)* domain.

2. The method of claim 1, wherein said transformation is a double Fourier transform.

3. The method of claim 1, wherein the Finn-Winbow method provides the corresponding map of τ .

4. A method for producing hydrocarbons from a subterranean region where the seismic velocity varies both laterally (with x) and vertically (with z), using common offset seismic data obtained from said region, said method comprising the steps:

a) selecting seismic velocity functions $v(z)$ at at least two lateral (x_s) locations in said subterranean region, the number of such locations being determined by the degree of lateral velocity variation;

b) transforming said common offset seismic data traces from the space-time *(x-t)* domain to the wave number - frequency *(k-ω)* domain;

c) calculating a travel time map for each x_s location using the velocity function selected for such location;

d) calculating for each travel time map from step (c) a corresponding map of τ as a function of wave number p, where $\omega\tau$ is the phase shift in the k-ω domain corresponding to the migration time shift in the x-t domain;

e) using the τ -maps to find τ *(p)* as a linear function of x with a certain slope at each depth *(z)* in the subterranean region;

f) forming the migrated image from said seismic traces in the ω-k domain using pre-stack time migration with k shifted by an amount equal to the τ slope from step (e) multiplied by ω;

g) reverse transforming said migrated image back to the space-time *(x-t)* domain;

h) using the migrated images from step (g) to assess the commercial hydrocarbon potential of the subterranean region; and

i) producing any hydrocarbons identified in step (h).